Relationships between Ozone and PM during CRPAQS

CRPAQS Data Analysis Task 2.7

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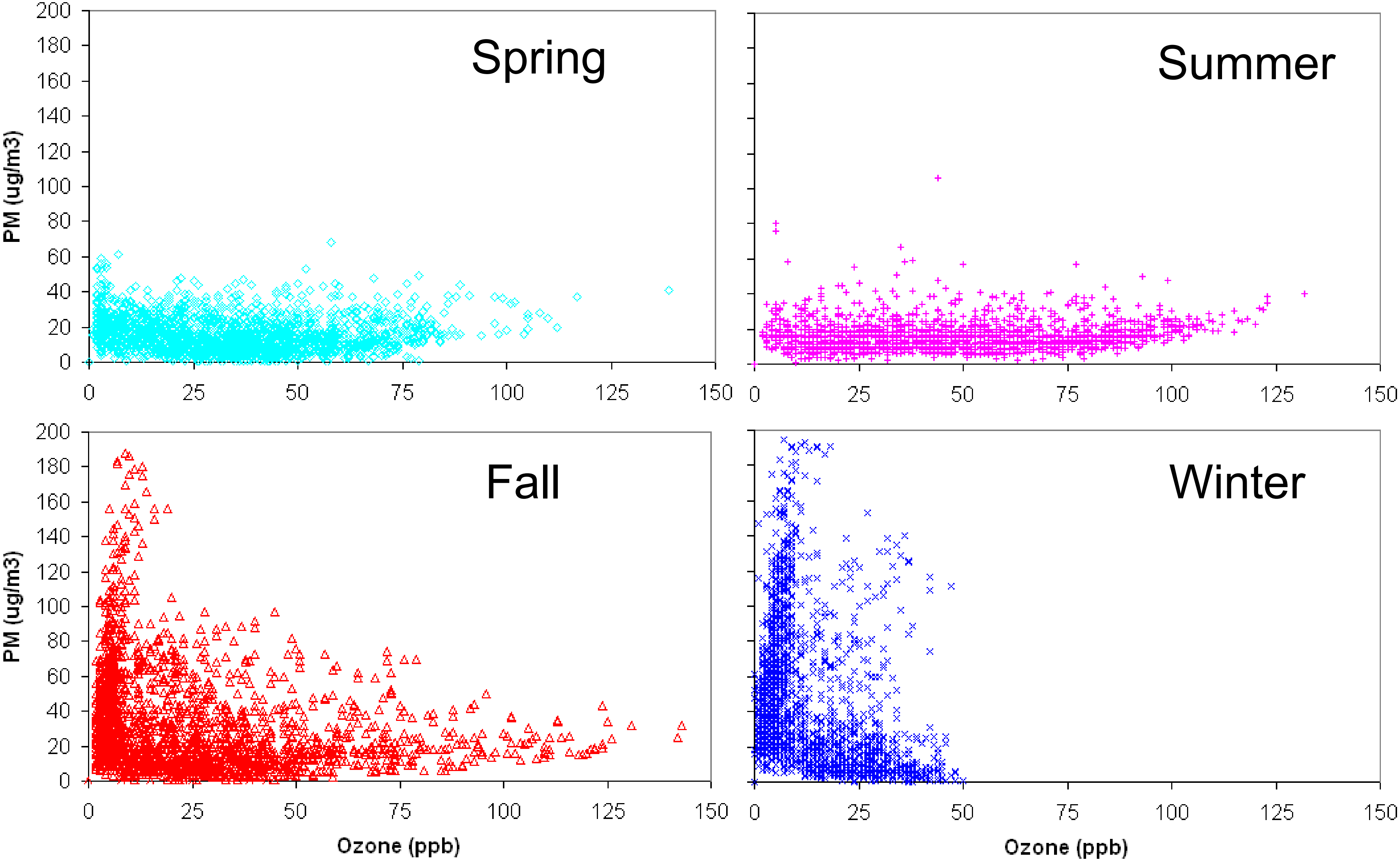
Discerning O_3-PM Relationships Hypotheses

- Some relationship must exist between O_3 and $PM_{2.5}$ because O_3 and key secondary $PM_{2.5}$ components are governed by the same precursors (NO_x and VOC)

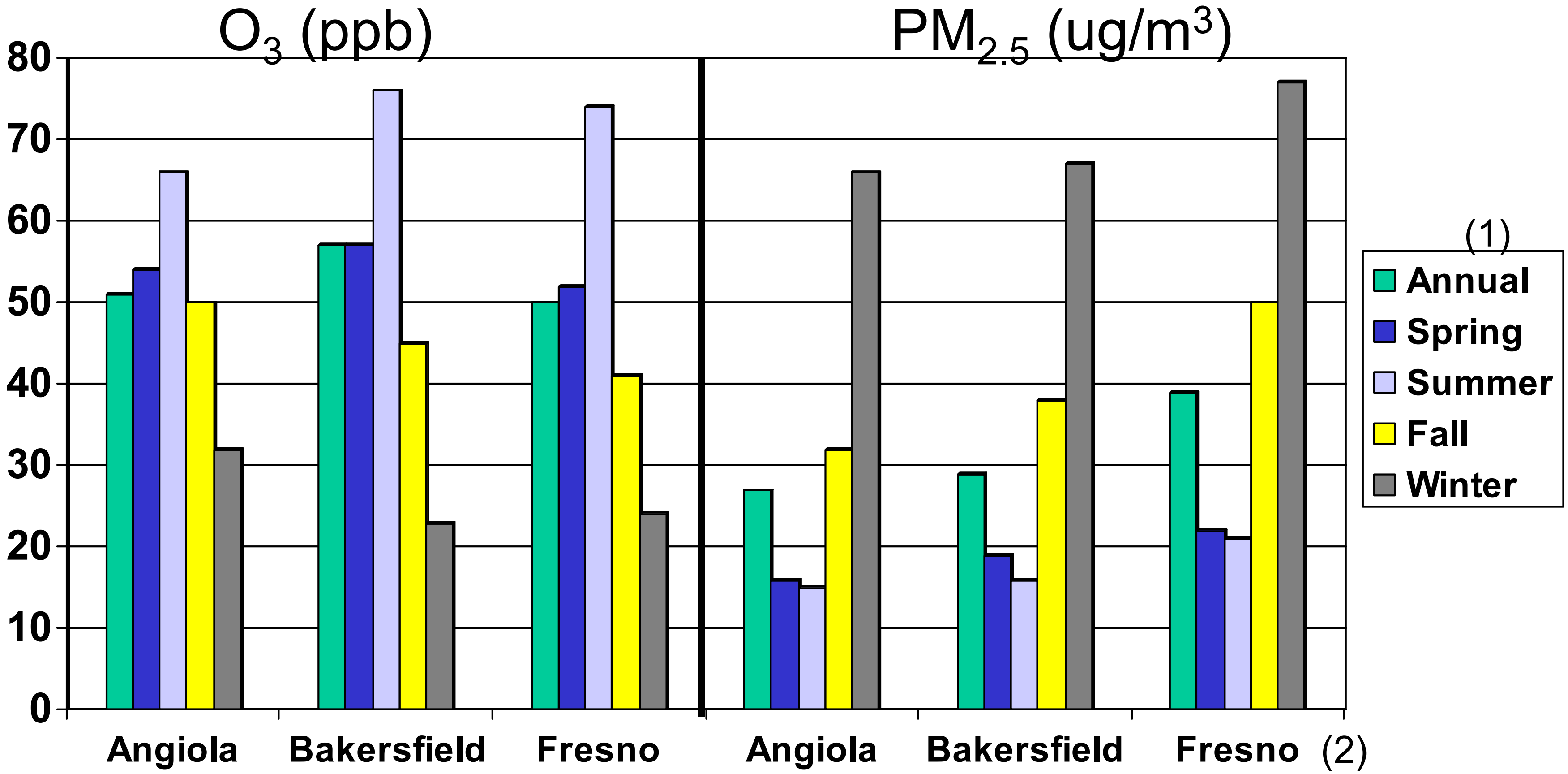
- Season-specific relationships: high O_3 predominantly occurs in summer, but high $PM_{2.5}$ occurs in winter

- Hourly data for $PM_{2.5}$ and O_3; continuous nitrate and OC data for Angiola, Bakersfield, Fresno downloaded from CRPAQS database (http://www.arb.ca.gov/airways/Datamainternance/default.asp)

Do High O_3 and $PM_{2.5}$ Occur Together? Fresno, Hourly Data



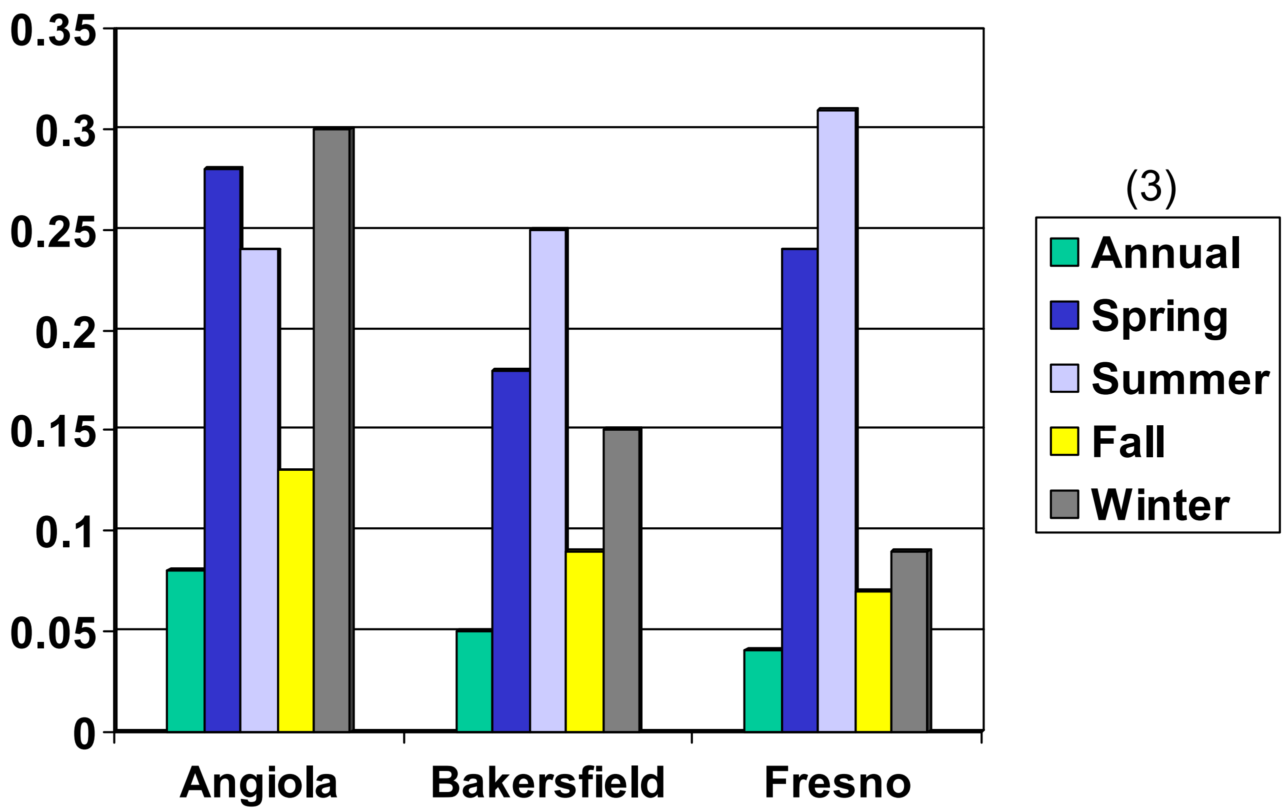
80th Percentile Ozone and PM Levels



(1) Spring: Mar to May; Summer: Jun to Aug; Fall: Sep to Nov; Winter: Dec to Feb

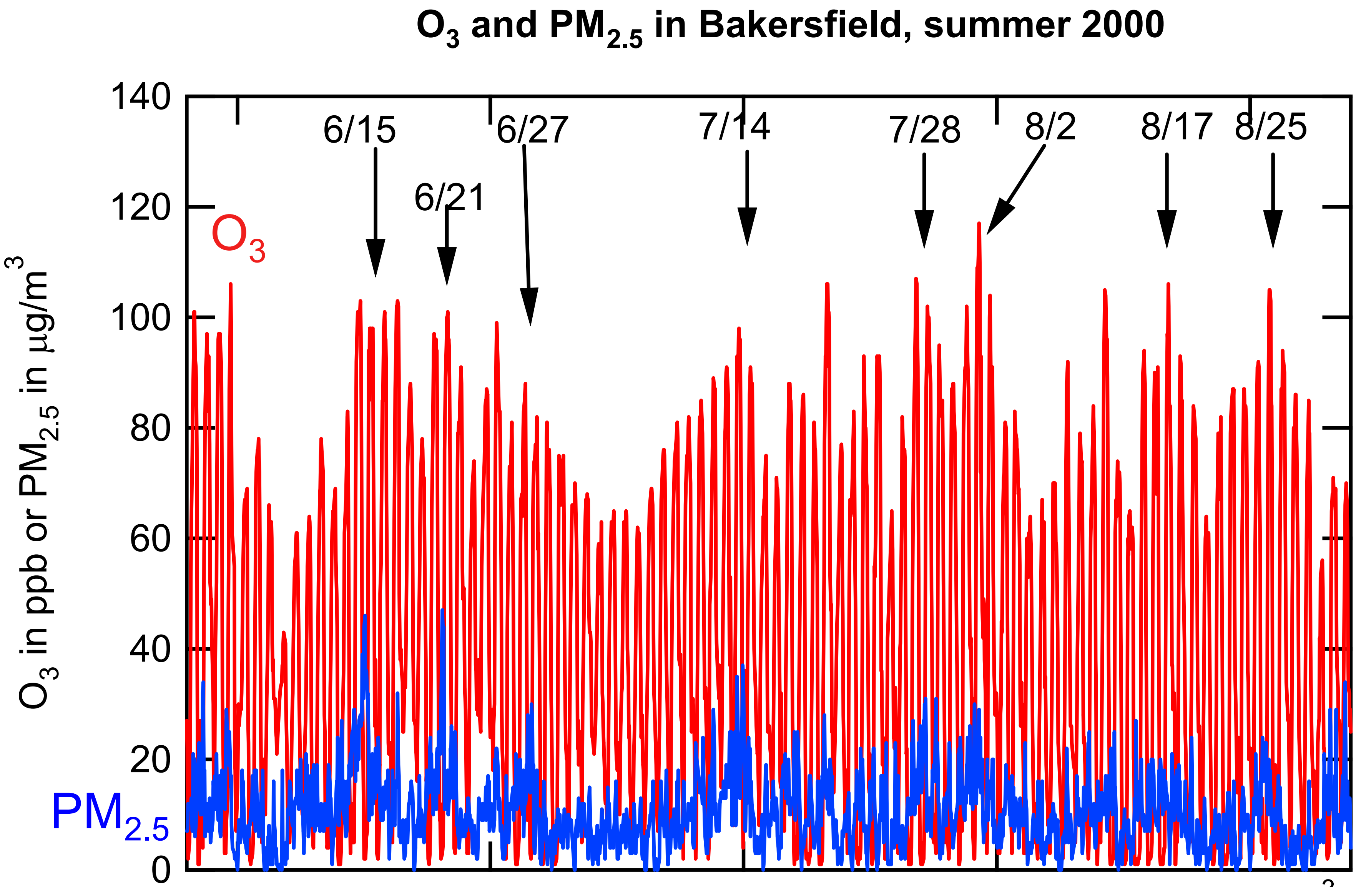
(2) Angiola: February 2000 - January 2001; Bakersfield & Fresno: January - December 2000

Conditional Probabilities [1]

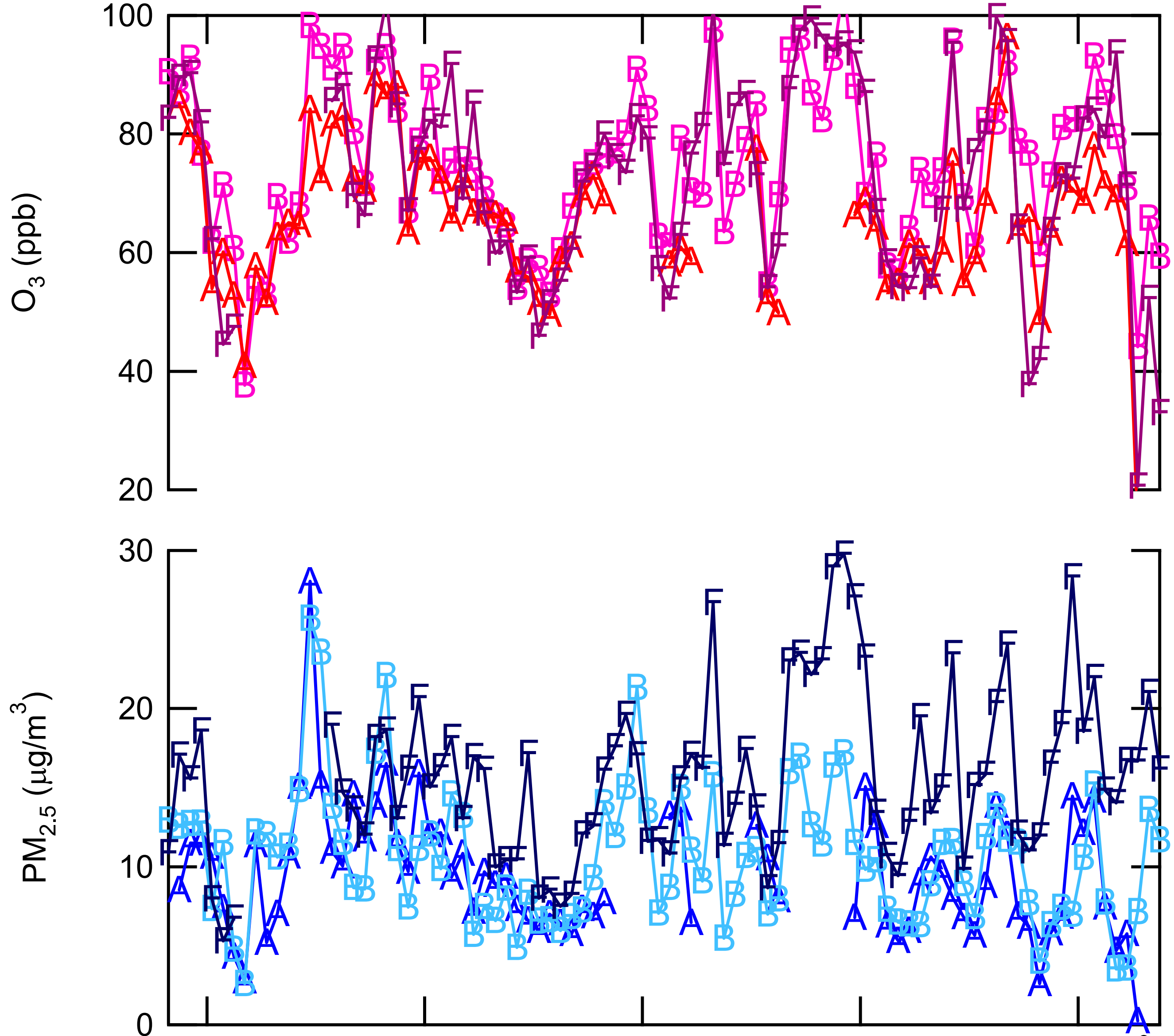


- P(high[2] O_3& PM|high PM) = P (high O_3&PM |high O_3)
- Top 20th percentile
- Spring: Mar to May; Summer: Jun to Aug; Fall: Sep to Nov; Winter: Dec to Feb

Summer Hourly Temporal Profiles



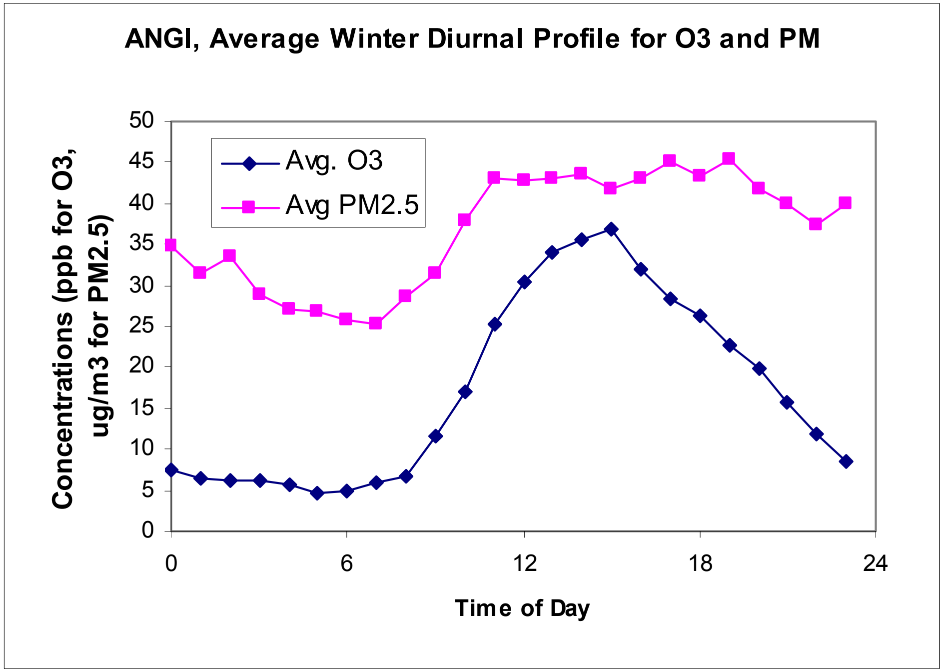
Summer Daily 24-hour Average $PM_{2.5}$ and Maximum 8-hour Average O_3 Time Series

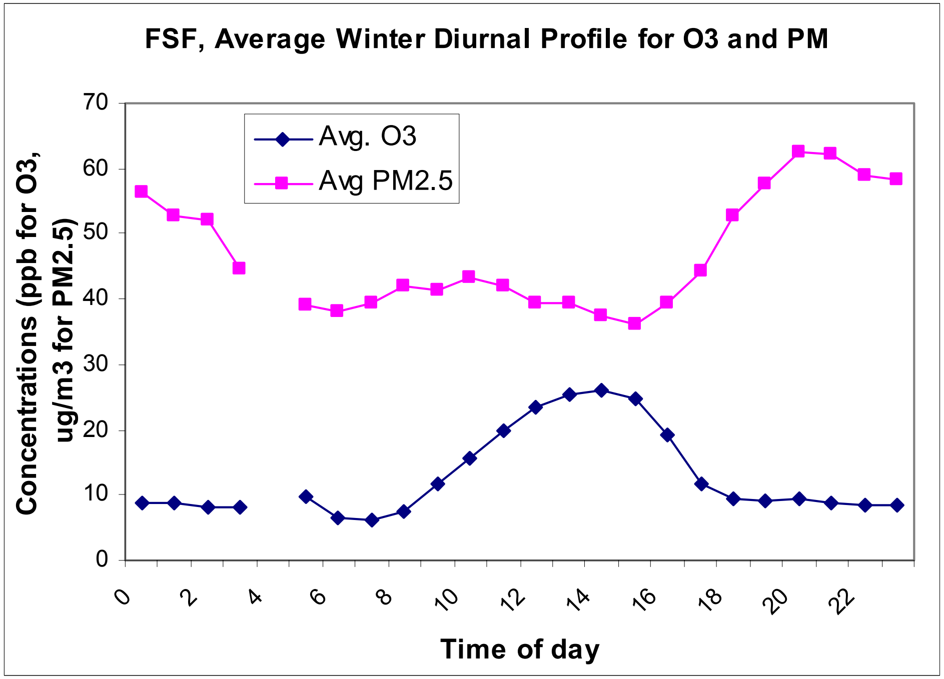


Key
A: Angiola
B: Bakersfield
F: Fresno

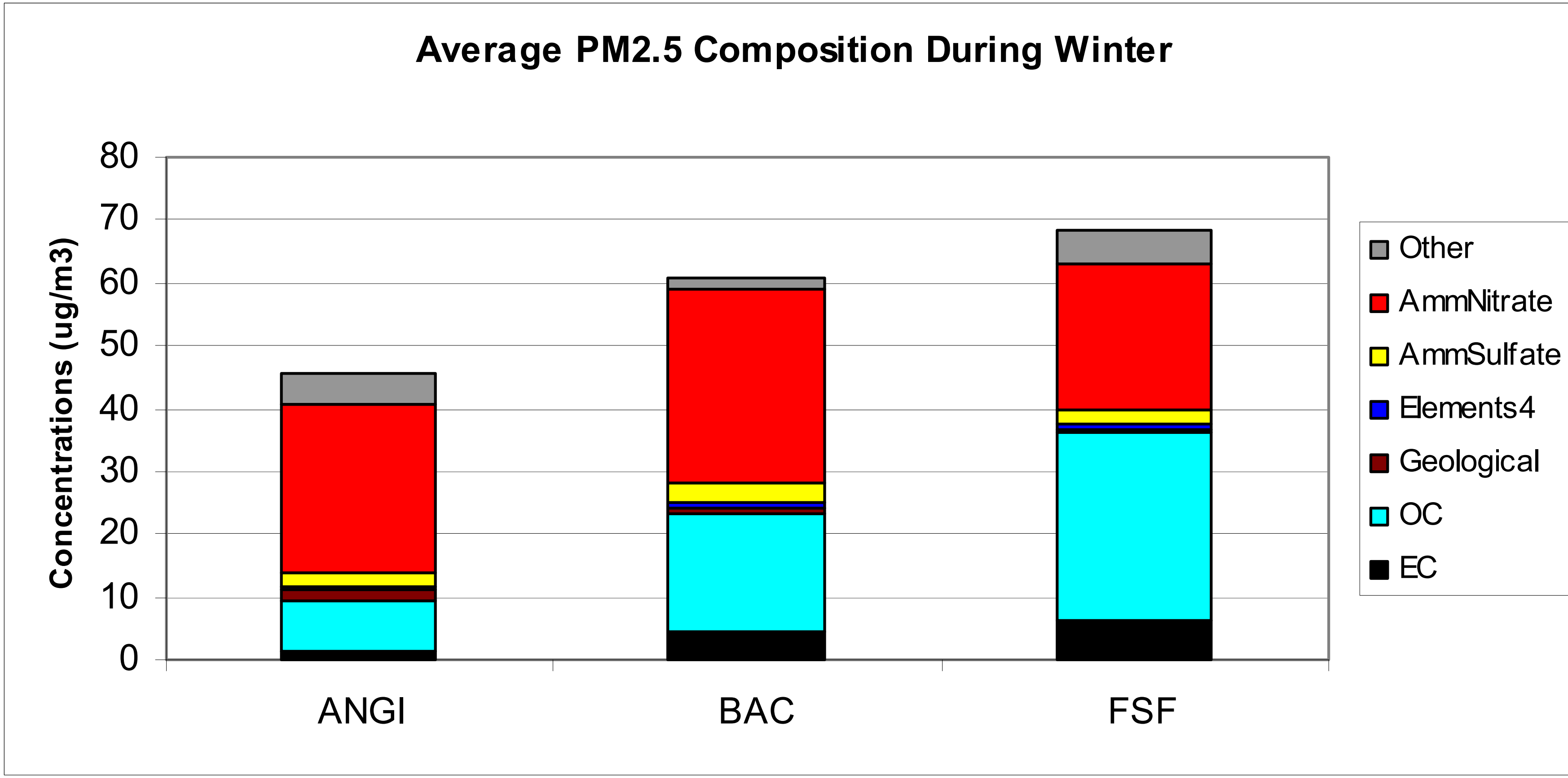
Winter Average Diurnal Profiles

- Peak $PM_{2.5}$ occurs during the day in Angiola (same phase as O_3)
- Peak $PM_{2.5}$ occurs at night in Fresno and Bakersfield (out of phase with O_3)





$PM_{2.5}$ Composition



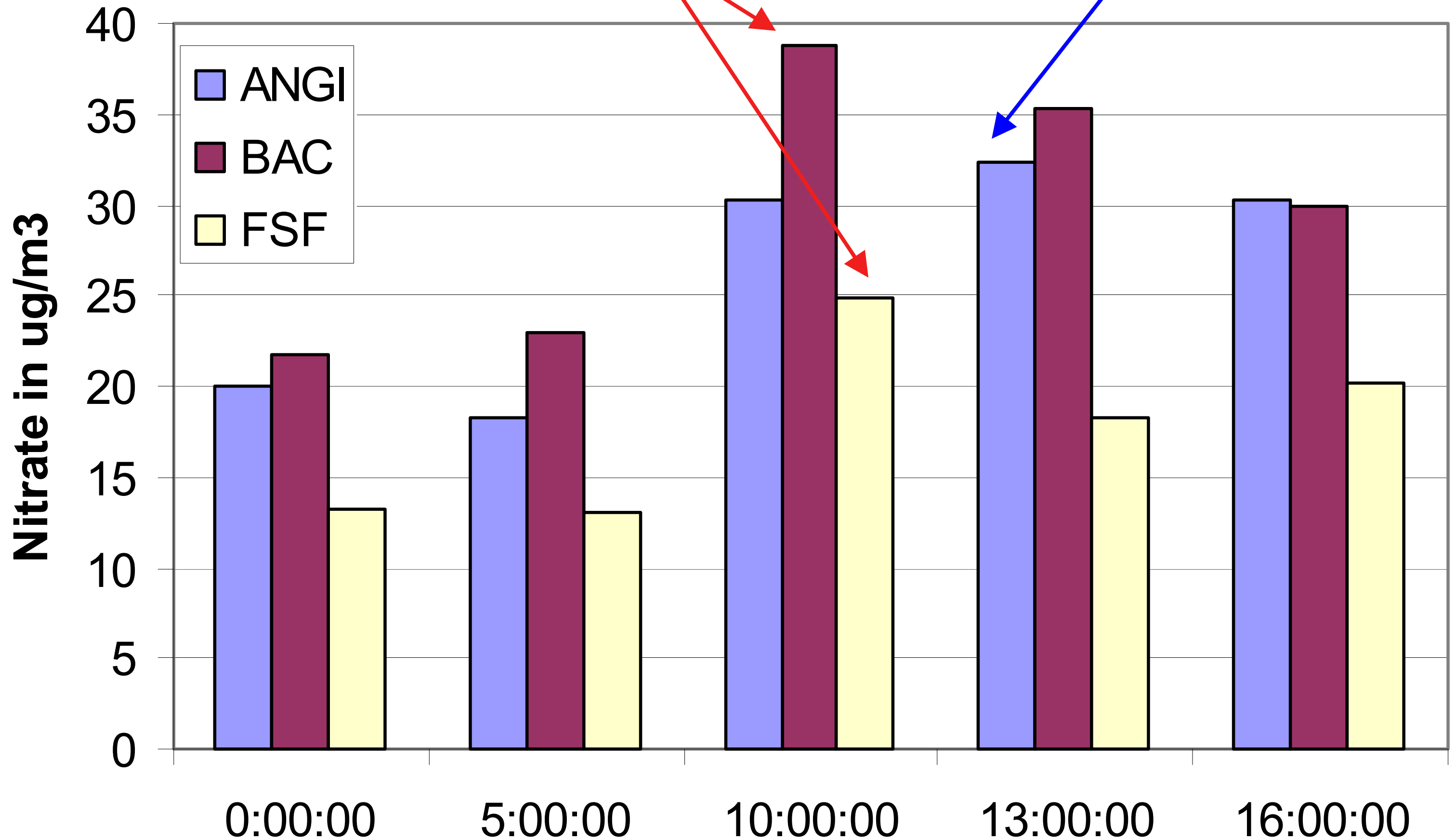
Average Nitrate Diurnal Profiles at Three Sites

Peak concentrations in BAC & FSF

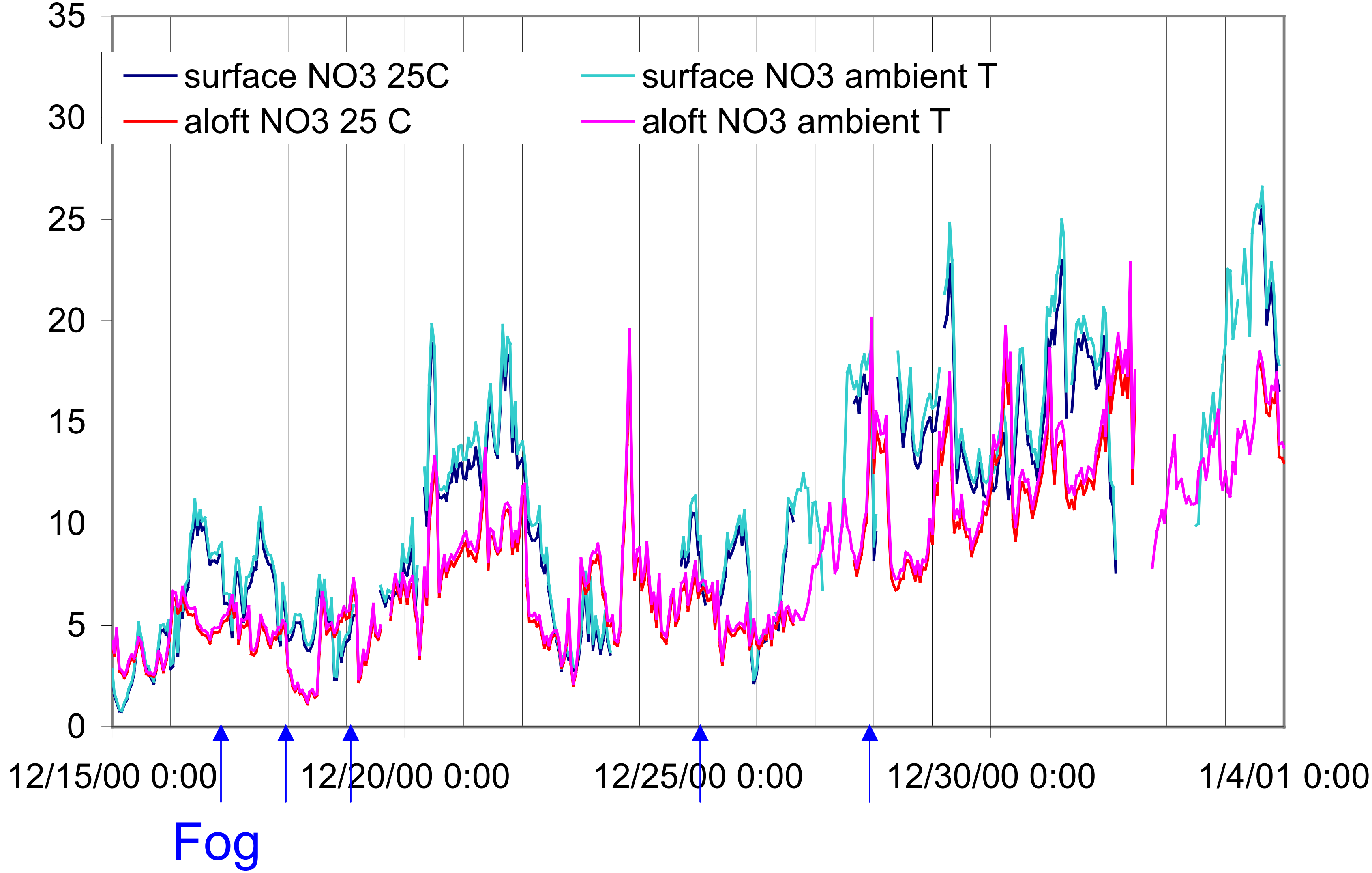
Nitrate aloft entered surface layer as mixing layer grows (Watson and Chow, 2002)

Peak concentrations in ANGI

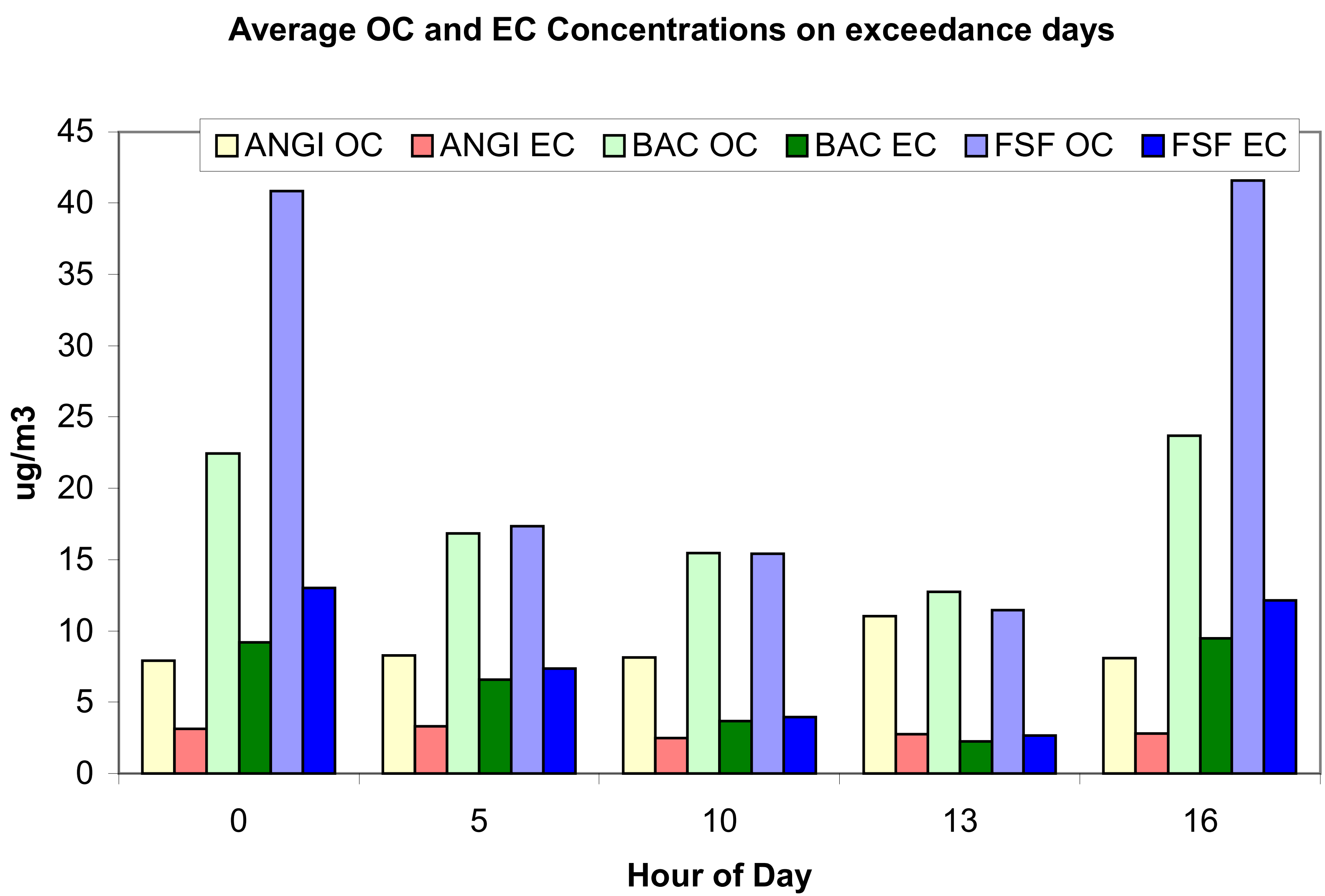
Daytime nitrate production



Surface and Aloft Nitrate in Angiola

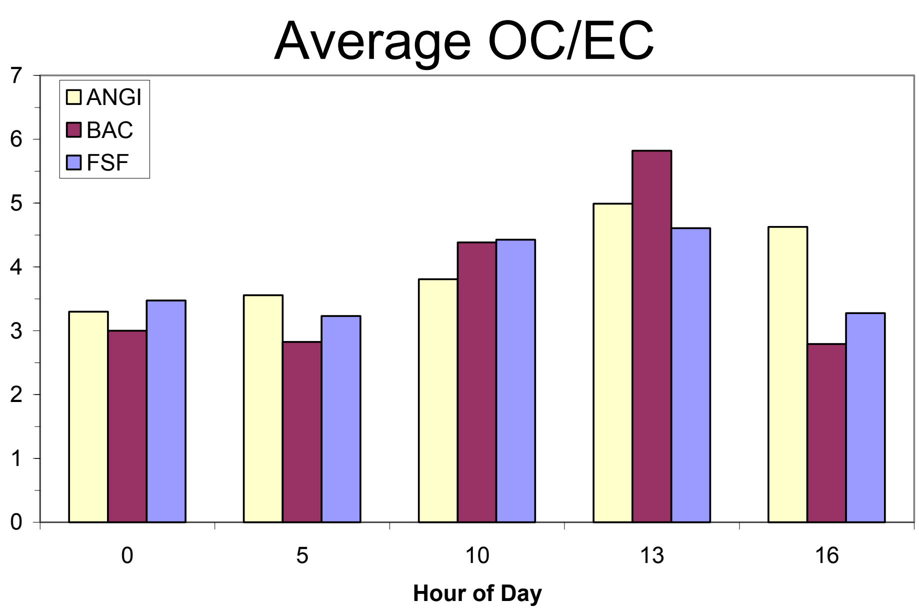


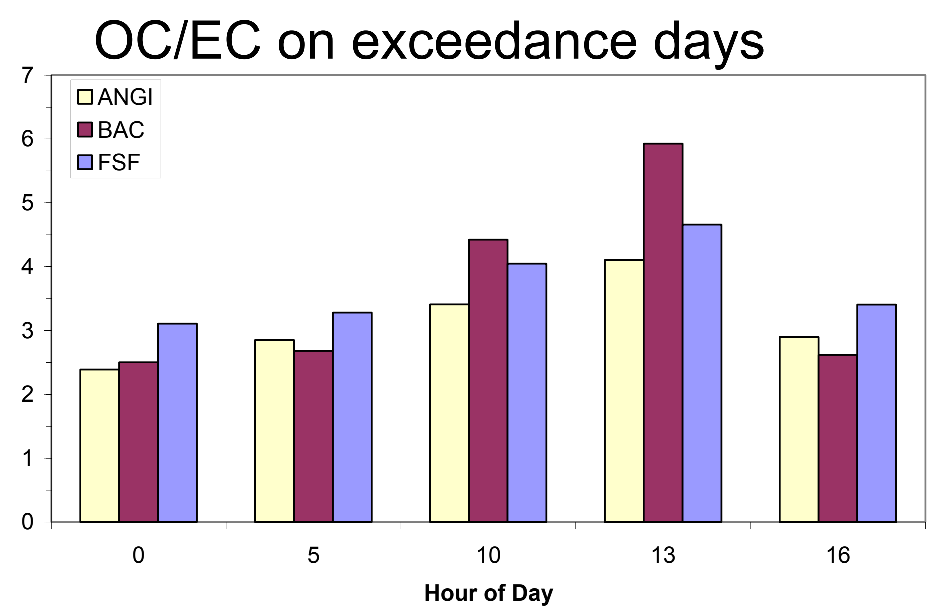
Winter OC and EC



Winter OC/EC

- High OC/EC ratios indicative of presence of secondary OC
- Stronger influence of primary emissions (lower OC/EC) on exceedance days in Angiola





Conclusions, Summer

- High O_3 and $PM_{2.5}$ occur more frequently in urban areas due to build-up of both pollutants
- There is no evidence of day-time urban-scale photochemical production of secondary PM
- There is no continuous data for the evaluation of contribution of secondary organic compounds

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Conclusions, Winter

- High O_3 and $PM_{2.5}$ occur more frequently in Angiola due to day-time peaks in both diurnal profiles
- $PM_{2.5}$ dominated by nitrate at Angiola, where day-time production can be important; this may be different from urban areas
- Organic compounds (primary) peak at night in Fresno & Bakersfield, driving $PM_{2.5}$. Influence of primary OC in Angiola increase on exceedance days
- Photochemical end products account for more than half of $PM_{2.5}$ in Angiola, but less than half in Bakersfield and Fresno